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Smoothing transformation and piecewise polynomial collocation for weakly singular Volterra integro-differential equations

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Abstract

We discuss a possibility to construct high order numerical methods on uniform grids for solving Volterra integro-differential equations with weakly singular kernels. Using an integral equation reformulation of the initial value problem, we apply to it a smoothing transformation so that the solution of the transformed equation does not contain any singularities in its derivatives up to a certain order. After that the transformed equation is solved by a piecewise polynomial collocation method on a mildly graded or uniform grid. Global convergence estimates are derived and some superconvergence results are given.